PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.:	10/828,420
Filing Date:	April 20, 2004
Applicant:	Scott Dewey et al.
Group Art Unit:	2829
Examiner:	Ernest F. Karlsen
Title:	HIGH VOLTAGE ISOLATION DETECTION OF A FUEL CELL SYSTEM USING MAGNETIC FIELD CANCELLATION
Attorney Docket:	GP-303953

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APPELLANT'S APPEAL BRIEF

This is Appellant's Appeal Brief filed in accordance with 37 CFR § 41.37 appealing the Examiner's Final Office Action mailed August 23, 2007. Appellant's Notice of Appeal was filed on November 19, 2007. The Appeal Brief fee is enclosed.

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I. Real Party in Interest

The real party in interest for this appeal is the General Motors Corporation of Detroit, Michigan, the assignee of this application.

II. Related Appeals and Interferences

There are no related appeals or interferences.

III. Status of the Claims

Claims 1-19 are pending. Claims 1-19 stand rejected. Claims 1-19 are on appeal. No claim has been cancelled. No claim has been allowed. No claim has been objected to.

IV. Status of Amendments

No amendments have been made.

V. Summary of Claimed Subject Matter

Claims 1 and 10 claim a fuel cell system and claim 15 claims a method for detecting a fault condition in a fuel cell system, such as fuel cell system 60 shown in figure 4, page 5, line 15, paragraph [0019]. The fuel cell system 60 includes a fuel cell stack 62 having a positive stack terminal 64 and a negative stack terminal 66, claims 1, 10 and 15, page 5, lines 18 and 19, paragraph [0019]. The positive terminal 64 is electrically coupled to a high voltage component 68 by an electrical conductor 70 and the negative terminal 66 is electrically coupled to the high voltage component 68 by an electrical conductor 72, claims 1, 10 and 15, page 5, lines 19-22, paragraph [0019]. The conductors 70 and 72 extend through an opening 34 in a magnetic field concentrator, such as torroid 32, claims 1, 10 and 15, page 5, lines 24 and 25, paragraph [0019]. A

sensor 42 is positioned within an opening in the magnetic field concentrator 32, and is electrically coupled to a current source 44, claims 1, 10 and 15, page 4, line 30 - page 5, line 1, paragraph [0017].

During normal stack operation, the current flowing through the conductors 70 and 72 is the same and in opposite directions so that the magnetic fields generated by the current flows through the conductors 70 and 72 cancel and the output of the amplifier 46 would be zero, page 5, lines 25-30. If the high voltage isolation of the system 60 fails where the high voltage component 68 becomes electrically coupled to ground, some of the current exiting the fuel cell stack 62 on the conductor 72 will not be returned to the fuel cell stack 62 on the conductor 70, and will be directed to ground, page 5, line 31 - page 6, line 2. Thus, the current propagating through the conductors 70 and 72 will be different depending on the magnitude of the isolation fault, and the magnetic fields will not completely cancel. The magnetic field difference between the magnetic fields generated by the conductors 70 and 72 will be detected by the sensor 42 that provides the signal to the amplifier 46, page 6, lines 4-9. A signal from the amplifier 46 is received by a controller 76 which will take the appropriate action, such as shutting down the fuel cell system, claims 1, 10 and 15, page 5, line 31 - page 6, line 15.

VI. Grounds of Rejection to be Reviewed on Appeal

Whether claims 1-19 should be rejected under 35 USC §103(a) as being unpatentable over U.S. Patent No. 6,998,819 issued to Jin (hereinafter Jin) in view of U.S. Patent No. 5,986,444 issued to Powell (hereinafter Powell) and U.S. Patent No. 2,946,955 issued to Kuhrt (hereinafter Kuhrt).

VII. Argument

A. Claims 1-19 are not obvious in view of Jin, Powell and Kuhrt

1. Independent claims 1, 10 and 15

Independent claims 1, 10 and 15 each include a high voltage component, a fuel cell stack including a positive terminal and a negative terminal, a first conductor electrically coupled to the positive terminal and the high voltage component, a second conductor electrically coupled to the negative terminal and the high voltage component, where a current propagating through the first and second conductors is in opposite directions, a magnetic field concentrator including an opening where the first and second conductors extend through the opening and where the first and second conductors generate magnetic fields that are concentrated by the magnetic field concentrator, and a magnetic sensor positioned in the magnetic field concentrator that detects the magnetic field, where the sensor provides a difference signal representative of the difference between the current propagating through the first and second conductors.

2. Discussion of Jin

Jin discloses a method for detecting leakage current in a high voltage battery pack system. The Jin method attempts to eliminate errors and leakage measurements as a result of fluctuations in battery module voltages by measuring all of the module voltages simultaneously while performing the leakage measurements, see column 4, lines 34 and 35. Jin does mention a fuel cell system in column 1, line 26, but only mentions the fuel cell system as part of a hybrid vehicle that includes a battery pack. Jin appears only to discuss detecting current leakage in the high voltage battery pack.

Appellant respectfully submits that Jin does not teach or suggest detecting leakage currents in a fuel cell system, and particularly detecting leakage currents in a fuel cell system using a detecting system that includes a first conductor electrically coupled to a positive terminal of a fuel cell stack and a high voltage component and a second conductor electrically coupled to a negative terminal of the fuel cell stack and the high voltage component. Further, Appellant respectfully submits that Jin does not teach or suggest using magnetic field cancellation for detecting a leakage current. Jin does teach detecting a leakage current, but not using magnetic field cancellation and not detecting a leakage current in a fuel cell system.

3. Discussion of Powell

Powell discloses a residual current device for detecting low magnitude electrical signals that includes conductors extending through an opening in a toroidally-shaped member 10, where current propagates through the conductors 12 in opposite directions. A magneto-resistor bridge 16 detects magnetic fields so that if the current through the conductors 12 is different, a magnetic field will be generated that can be detected.

Appellant respectfully submits that Powell does not teach or suggest detecting electrical isolation fault conditions in a fuel cell system. Column 2, lines 33 and 34 of Powell states that the conductors 12 "[a]re respectively connected to the live and neutral supplies to the residual current device." There does not appear to be any other discussion in Powell of connecting the conductors 12 to a current generating device, and there clearly is no teaching or suggestion in Powell of electrically coupling one of the conductors to a positive terminal of a fuel cell stack and a high voltage component and the other conductor 12 to the negative terminal of the fuel cell stack and the high voltage component.

4. Discussion of Kuhrt

Kuhrt discloses a current measuring device that employs a magnetic field-responsive resistor 1 for detecting current. The resistor 1 is part of a bridge circuit including resistors 3, 4 and 5 that detects the current flow through a conductor 2.

Appellant respectfully submits that there is no teaching in Kuhrt of detecting an isolation fault using magnetic field cancellation, and no teaching of detecting an isolation fault in a fuel cell system.

5. Discussion

Appellant acknowledges that fault isolation detection systems are known to be used in fuel cell systems for safety purposes, as discussed in paragraphs [0007] and [0008] of the specification. However, in order to address some of the drawbacks with the fault isolation detection systems used in the art for fuel cell systems, Appellant's invention employs magnetic field cancellation for the fault detection, as claimed. Appellant respectfully submits that the Examiner has not established a *prima facie* case of obviousness by the combination of Jin, Powell and Kuhrt because there is no teaching in these references of detecting isolation fault failures in a fuel cell system using magnetic field cancelling. Particularly, there is no nexus for using magnetic field cancelling to detect a current flow difference for a current flowing to a fuel cell stack and a current flowing from a fuel cell stack. Appellant submits that the prior art does not teach providing two wires extending through a magnetic field concentrator, where the wires are electrically coupled to a fuel cell stack and a high voltage component. Jin does not teach detecting leakage currents by magnetic field cancellation and Powell only teaches detecting fault currents using magnetic field cancellation without being

specific to the system generating the fault. Therefore, Appellant submits that the §103(a) rejection should be withdrawn.

VIII. Conclusion

As discussed above, Appellant respectfully submits that the Examiner has not established a *prima facie* case of obviousness by the combination of Jin, Powell and Kuhrt. It is therefore respectfully requested that the §103(a) rejection be reversed.

Respectfully submitted,

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CLAIMS APPENDIX

COPY OF CLAIMS INVOLVED IN THE APPEAL

1. A fuel cell system comprising:

a high voltage component;

a fuel cell stack including a positive terminal and a negative terminal;

a first conductor electrically coupled to the positive terminal and the high voltage component;

a second conductor electrically coupled to the negative terminal and the high voltage component, wherein a current propagating through the first and second conductors is in opposite directions;

a magnetic field concentrator including an opening, said first and second conductors extending through the opening, wherein a current propagating through the first and second conductors generate magnetic fields that are concentrated by the magnetic field concentrator; and

a magnetic sensor positioned relative to the magnetic field concentrator, said sensor detecting the magnetic field in the magnetic field concentrator and providing a difference signal representative of the difference between the current propagating through the first conductor and the current propagating through the second conductor.

2. The system according to claim 1 further comprising an amplifier, said amplifier being responsive to the difference signal from the sensor and providing an amplified output signal indicative of the difference between the current propagating through the first conductor and the current propagating through the second conductor.

3. The system according to claim 1 wherein the sensor is a Hall effect sensor.

4. The system according to claim 3 further comprising a current source, said current source providing a current to the sensor.

5. The system according to claim 1 wherein the magnetic field concentrator is a torroid.

6. The system according to claim 5 wherein the sensor is positioned within the torroid.

7. The system according to claim 5 wherein the torroid is a ferrite torroid.

8. The system according to claim 1 wherein the high voltage component is a vehicle component.

9. The system according to claim 8 wherein the difference signal generated by the sensor represents a fault detection of an electrical isolation system.

10. A fuel cell system comprising:

a high voltage component;

a fuel cell stack including a positive terminal and a negative terminal;

a first conductor electrically coupled to the positive terminal and the high voltage component;

a second conductor electrically coupled to the negative terminal and the high voltage component, wherein a current propagating through the first and second conductors is in opposite directions and generate magnetic fields; and

a magnetic sensor positioned relative to the first and second conductors, said sensor detecting a combined magnetic field and providing a difference signal representative of the difference between the current propagating through the first conductor and the current propagating through the second conductor, wherein the difference signal generated by the sensor represents a fault detection of an electrical isolation system.

11. The system according to claim 10 further comprising a torroid including an opening, said first and second conductors extending through the opening, said sensor being positioned within the torroid.

12. The system according to claim 10 further comprising an amplifier, said amplifier being responsive to the difference signal from the sensor and providing an amplified output signal indicative of the difference between the current propagating through the first conductor and the current propagating through the second conductor.

13. The system according to claim 10 wherein the sensor is a Hall effect sensor.

14. The system according to claim 10 wherein the high voltage component is a vehicle component.

15. A method of detecting a fault condition of an isolation system in a fuel cell system, said method comprising:

providing a high voltage component;

providing a fuel cell stack including a positive terminal and a negative terminal;

electrically coupling a first conductor to the positive terminal and the high voltage component;

electrically coupling a second conductor to the negative terminal and the high voltage component, wherein a current propagating through the first and second conductors is in opposite directions and generate magnetic fields;

detecting the magnetic fields generated by the first and second conductors; and

providing a signal representative of the difference between the current propagating through the first conductor and the current propagating through the second conductor from the detected magnetic field.

16. The method according to claim 15 wherein detecting the magnetic fields generated by the first and second conductors includes detecting the magnetic fields generated by the first and second conductors by a magnetic sensor.

17. The method according to claim 16 wherein detecting the magnetic fields generated by the first and second conductors includes detecting the magnetic fields generated by the first and second conductors by a magnetic sensor positioned within a torroid, wherein the first and second conductors extend through an opening in the torroid.

18. The method according to claim 15 wherein detecting the magnetic fields generated by the first and second conductors includes detecting the magnetic fields generated by the first and second conductors by a Hall effect sensor positioned within a torroid, wherein the first and second conductors extend through an opening in the torroid.

19. The method according to claim 15 wherein the high voltage component is a vehicle component.

EVIDENCE APPENDIX

There is no evidence pursuant to §1.130, §1.131 or §1.132.

RELATED PROCEEDINGS APPENDIX

There are no decisions rendered by a court or the Board in any proceeding identified in Section II of this Appeal Brief.